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1990 Rivers Inlet Echo Sounding Program Summary Report

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Fisheries Branch
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Canadian Data Report of
Fisheries and Aquatic Sciences
No. 810

Canadian Data Report of Fisheries and Aquatic Sciences

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ABSTRACT

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Sockeye salmon escapement past the Rivers Inlet (Department of Fisheries and Oceans, Statistical Area 9) commercial fishery is monitored by an echo sounding program conducted at the head of the inlet. This report summarizes the field data collected during the 1990 Rivers Inlet echo sounding program.

RESUME

Winther, I. 1990. 1990 Rivers Inlet echo sounding program: summary report. Can. Data Rep. Fish. Aquat. Sci. # 810. iii + 15 p.

La peche commerciale du saumon sockeye qui remonte le bras de mer Rivers (ministere des Peches et des Oceans, secteur statistique no 9) est controlee au moyen d'un systeme d'echo-sondage mis en place a l'extremite du bras de mer. Ce rapport recapitule les donnees fournies par le programme d'echo-sondage du bras de mer Rivers durant 1990.

INTRODUCTION

Rivers Inlet is located in the Department of Fisheries and Oceans Statistical Area 9 in the Central Coast area of British Columbia (Fig. 1). Rivers Inlet has the largest returning sockeye stock in the Central Coast. Owikeno Lake and its tributaries produce the majority of Rivers Inlet sockeye. The Wannock River drains Owikeno Lake into Rivers Inlet.

After passing through the Rivers Inlet fishing area (management subareas 9-2,3,4 & 11) sockeye tend to hold at the head of Rivers Inlet before continuing up the Wannock River. Wood and Mason (1971) determined that the Rivers Inlet sockeye stock size could be estimated using hydroacoustic techniques.

Goruk and Thomson (1988) and Wood and Mason (1971) discussed characteristics of the Rivers Inlet sockeye salmon stock used in determining the hydroacoustic sampling procedure. Dense daytime schools of sockeye ascend and disperse at night allowing individual salmon targets to be distinguished on the echogram. Most of the targets (95 to 99%) are found in the top 10 fathoms. Adult salmon tend to avoid the freshwater layer that exists at the surface of the inlet thus minimizing vessel avoidance to some extent.

The Rivers Inlet Echosounding Program has been operated since 1967. Data collected during the program is used inseason to manage the commercial sockeye fishery.

METHODS

The Rivers Inlet Echosounding program was conducted from July 10 to July 25, 1990. The Walker Rock, a 12 m seine vessel belonging to the Department of Fisheries and Oceans, was used for the program. The Walker Rock was equipped with a Simrad EY-M dry paper recorder and a Simrad 74AA/AP (70 kHz) transducer. The beam angle of the transducer has been measured at 30 degrees. The Simrad EY-M recorder was operated at settings of Gain = 9 and Time-varied Gain (TVG) = 40 log R. A Furuno color echosounder was used when navigating to and from the grid site. The echosounders were used individually because of interference created when both units were operated. No quantitative data was collected with the Furuno color echosounder.

Eleven transects in the Miss Robyn and R.D. 102 grids were sounded nightly (Fig. 2). Soundings began after dusk at the head of the inlet and continued seaward to the last transect off McAllister Point. Soundings were completed before dawn. Soundings were initiated and terminated one cable (180 m) from the beach. The echogram was marked at the start and end of each transect. The duration of each transect was timed with a stopwatch. The engine speed of the Walker Rock was kept at 800 R.P.M. during transects.

Targets on the echogram were counted in five depth divisions between 1 and 10 m. The depth divisions were 1-2 m, 2-3 m, 3-5 m, 5-7 m, and 7-10 m.

Calculations for estimating sockeye abundance from echosounding counts are described by Goruk and Thomson (1988). A micro computer was used to perform the calculations.

RESULTS & DISCUSSION

Table 1 and Figure 3 show the 1990 Rivers Inlet daily sockeye estimates in the echosounding grid area. The daily sockeye estimate in the grid increased to a peak of 374,338 on the night of July 22/23. A large body of fish was reported moving up the Wannock River on July 23. Subsequently the daily estimate declined to near 300,000. Weather and transect time data appear in the Field Notes.

Four commercial fisheries were held to target on Rivers Inlet sockeye stocks. Two 48 hour fisheries began at 18:00 hours of July 2 and 9, and two 24 hour fisheries began at 18:00 hours of July 16 and 29. Fishing was open to gillnet and troll gear in management subareas 9-2, 9-3, 9-4 and 9-11. Gillnets were restricted to a minimum mesh size of 150 mm. Subsequent fisheries were held to test chum salmon returns and harvest pink salmon. A maximum mesh restriction of 133 mm was imposed on the fishery beginning at 18:00 hours of August 5 and closing at 18:00 hours of August 9. There were no mesh restrictions on subsequent fisheries. Fisheries beginning at 18:00 of August 5, 12 and 19 were open to gillnet and troll gear in management subareas 9-2, 9-3, 9-4, 9-7 and 9-11. The fishery beginning at 18:00 August 26 was restricted to part of management area 9-3 only. Table 2 shows commercial gillnet catch by day in Rivers Inlet.

The Owekeeno Band harvested food fish at the head of Rivers Inlet by gillnet and in the Wannock River by gillnet and beach seine. Total catch to August 15 was 697 sockeye, 155 pink, and 18 chum.

Scale samples were collected from sockeye caught in the commercial gillnet fishery. Age results are given in Table 3. Age 512 sockeye composed 84.2 % of the samples.

Tidal heights at Wadhams, Rivers Inlet for the month of July 1990 appear in Figure 4. A tide table for Wadhams appears in Appendix 1.

REFERENCES

Goruk, R.D. and B.L. Thomson. 1988. Rivers Inlet echo sounding program 1967-1988. Can. Man. Rep. Fish. Aquat. Sci. 1989. iii + 27 p. + Appendices.

Wood, F.E.A. and B. Mason. 1971. Echo sounder enumeration of Rivers Inlet sockeye salmon, 1967-1970. Tech. Report 1971-12, Canadian Dept. Fisheries and Forestry, Fisheries Service.

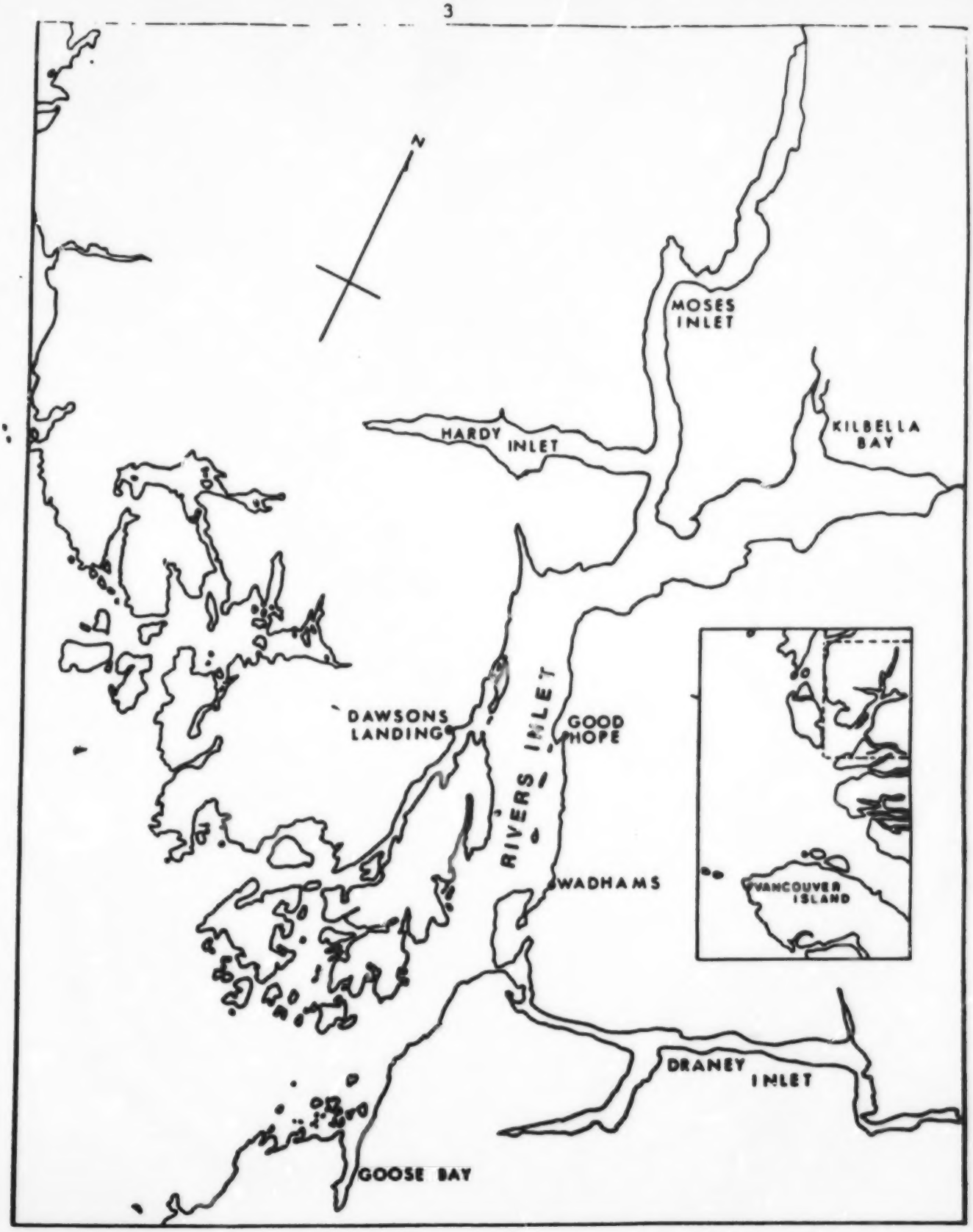


FIGURE 1. Rivers Inlet (Statistical Area 9), B.C.

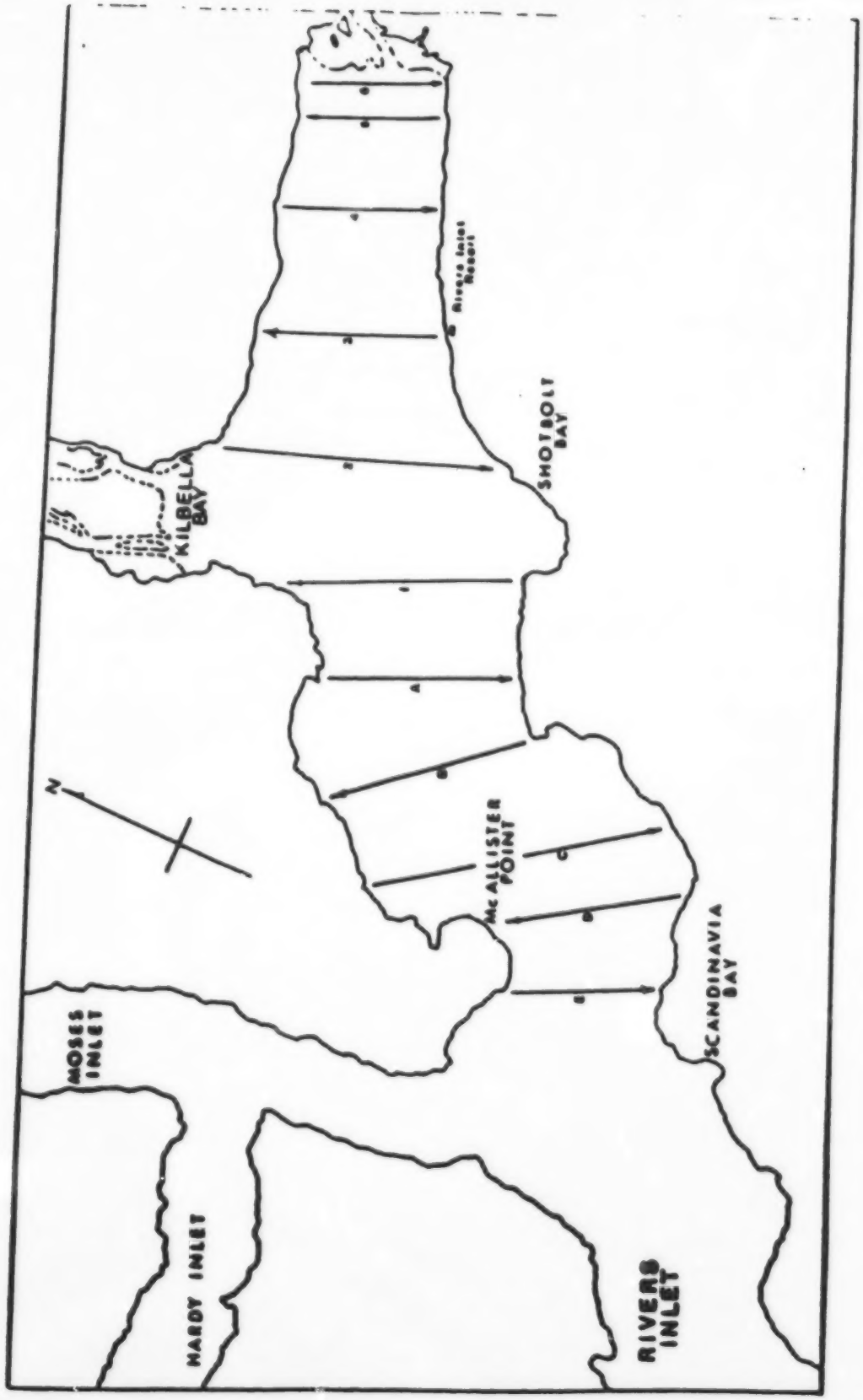


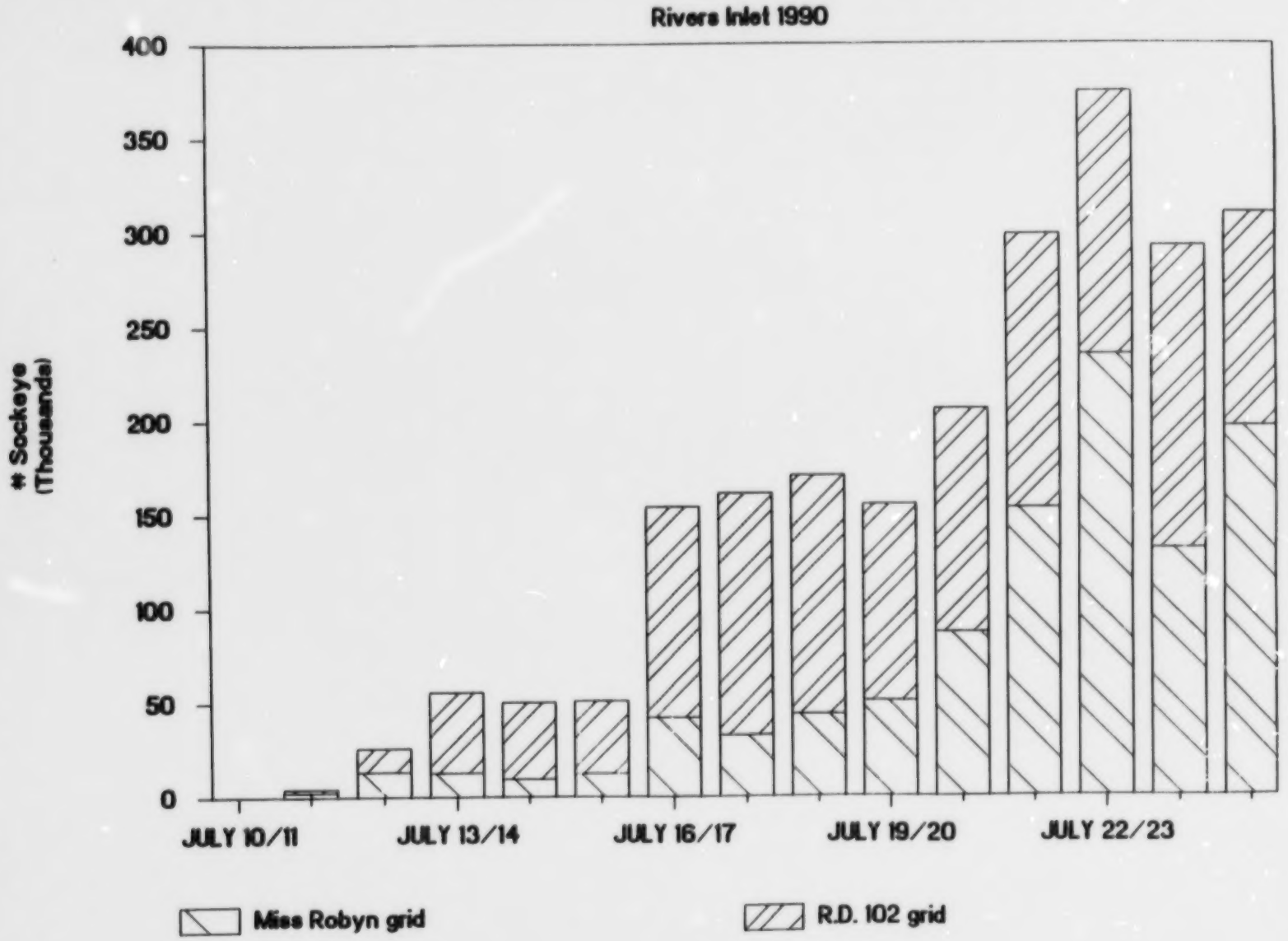
FIGURE 2. Miss Robyn Grid and R.D. 102 Grid, Rivers Inlet.

Table 1: 1990 ECHO BOUNDING RESULTS

	MISS ROBYN GRID						TOTAL	RD 102 GRID					TOTAL	TOTAL
							MISS						RD 102	ALL
DATE	6	5	4	3	2	1	ROBYN	A	B	C	D	E	GRID	GRIDS
JULY 10/11									0		0		0	
JULY 11/12	89	98	158	436	1436	437	2655	0	408	542	259	341	1550	4205
JULY 12/13	0	209	1206	2264	9364	437	13481	1551	8601	1265	259	782	12468	25949
JULY 13/14	0	0	1565	0	6090	5390	13045	7976	14480	9269	5456	5387	42567	55612
JULY 14/15	0	0	158	0	2068	7372	9598	11997	5378	11998	5715	5473	40560	50158
JULY 15/16	0	0	3149	4121	862	4109	12242	4493	5107	17527	7529	4178	38834	51076
JULY 16/17	0	283	5005	3803	10774	22296	42115	16695	26812	37425	23520	7363	111815	153930
JULY 17/18	258	1129	536	3571	16003	11279	32756	15011	31021	40623	22173	19546	128374	161130
JULY 18/19	0	656	3837	436	17383	22353	43665	30651	18993	29746	33334	14131	126856	170520
JULY 19/20	0	0	1006	13322	9653	26524	50504	19912	26602	32331	17083	8887	104815	155319
JULY 20/21	179	209	5048	17854	19825	43923	87039	28297	33286	32316	17168	7778	118845	205884
JULY 21/22	1138	348	8490	33704	45574	63635	152888	35020	60897	29368	15924	4649	145859	298747
JULY 22/23	585	543	16645	62857	79757	74394	234781	33088	48833	31630	18670	7337	139557	374338
JULY 23/24	238	1938	36146	20816	20461	51741	131339	54148	55874	32914	10518	7479	160933	292273
JULY 24/25	232	2592	22096	37306	78257	55792	196274	28723	21138	28484	23314	12083	113742	310017

Ø'S MAY DIFFER SLIGHTLY FROM FIELD SHEET TOTALS DUE TO ROUNDING ERRORS

Figure 3: Echosounding Estimates



1990 Rivers Inlet Echosounding Program Field Notes:

These notes consist of a diary of the times each transect was run, weather and water conditions and sightings of fish. Times of each transect have been collected for correlation with tidal information. Exact duration of each transect was recorded with a stop watch for use in the calculations of fish density.

The Department of Fisheries and Oceans MV Walker Rock was operated by Captain T.R. (Bob) Alton. Ivan Winther (Biologist, Central Coast) conducted the echosounding.

During each transect the Walker Rock was run at a speed of 800 RPM with the Simrad EY-M paper sounder set at gain = 9 and TVG = 40 log R.

July 10/11 Depart Dawsons 2200, return 0130. Weather clear and calm. Hot during the day, winds westerly to 25 kn in the afternoon. No jumpers. One trace off of Stone Point.

	Transect Time START	END	Duration (min : sec)
R.D. 102 - B	23:14	23:24	10 : 12.91
R.D. 102 - D	23:45	00:00	14 : 58.00

July 11/12 Depart Dawsons 2110, return 0430. Weather clear, wind W 5-10 kn. Killer whales inside of Stone Point. Blew a fuse between transects 5 and 6.

Miss Robyn 6	23:04	23:12	8 : 09.13
Miss Robyn 5	23:13	23:22	9 : 09.66
Miss Robyn 4	00:16	00:27	10 : 36.02
Miss Robyn 3	00:34	00:47	13 : 49.31
Miss Robyn 2	00:55	01:20	25 : 16.61
Miss Robyn 1	01:26	01:47	21 : 01.93
R.D. 102 - A	01:56	02:11	14 : 38.92
R.D. 102 - B	02:15	02:30	14 : 07.00
R.D. 102 - C	02:35	02:57	22 : 22.93
R.D. 102 - D	03:03	03:18	15 : 05.89
R.D. 102 - E	03:23	03:35	12 : 18.64

July 12/13 Depart Dawsons 2050, return 0330. Weather clear, wind W 0-5, calm after 2400.

Miss Robyn 6	22:47	22:55	8 : 09.92
Miss Robyn 5	22:56	23:06	9 : 52.67
Miss Robyn 4	23:11	23:34	12 : 36.38
Miss Robyn 3	23:29	23:43	14 : 12.17
Miss Robyn 2	23:50	00:13	23 : 12.24
Miss Robyn 1	00:18	00:39	20 : 58.80
R.D. 102 - A	00:47	01:00	13 : 06.86
R.D. 102 - B	01:05	01:19	14 : 47.31
R.D. 102 - C	01:24	01:45	21 : 17.37
R.D. 102 - D	01:51	02:06	15 : 06.40
R.D. 102 - E	02:11	02:24	12 : 51.94

July 13/14 Depart Dawsons 2045, return 0315. Weather clear, wind W 0-5, calm after 2400. Strong tides. No jumpers.

Miss Robyn 6	22:36	22:44	8 : 42.24
Miss Robyn 5	22:46	22:57	10 : 48.55
Miss Robyn 4	22:03	23:15	11 : 47.94
Miss Robyn 3	23:19	23:32	12 : 29.73
Miss Robyn 2	23:39	00:00	20 : 42.20
Miss Robyn 1	00:05	00:26	21 : 05.65
R.D. 102 - A	00:33	00:46	12 : 33.52
R.D. 102 - B	00:49	01:03	13 : 50.78
R.D. 102 - C	01:07	01:27	19 : 56.14
R.D. 102 - D	01:32	01:46	14 : 16.33
R.D. 102 - E	01:50	02:03	12 : 34.23

July 14/15 Depart Dawsons 2055, return 0300. Weather clear, wind W 0-5. Killer whales past Dawsons landing at 1900. Good sign of fish between Darby Channel and Rutherford Point.

Miss Robyn 6	22:36	22:45	8 : 47.05
Miss Robyn 5	22:46	22:56	9 : 30.39
Miss Robyn 4	23:00	23:13	12 : 05.86
Miss Robyn 3	23:18	23:32	14 : 09.60
Miss Robyn 2	23:40	00:02	21 : 54.40
Miss Robyn 1	00:08	00:28	20 : 39.81
R.D. 102 - A	00:35	00:48	13 : 33.34
R.D. 102 - B	00:52	01:05	13 : 16.93
R.D. 102 - C	01:10	01:31	20 : 54.75
R.D. 102 - D	01:37	01:51	14 : 15.01
R.D. 102 - E	01:54	02:06	11 : 50.82

July 15/16 Depart Dawsons 2055, return 0300. Weather overcast, wind W 5-10. Fishery open 1800. First sets on the Stone Point line were 50% pinks. Over 200 vessels fishing on or near Stone Point.

Miss Robyn 6	22:26	22:35	8 : 51.89
Miss Robyn 5	22:36	22:46	9 : 40.65
Miss Robyn 4	22:50	23:03	13 : 20.00
Miss Robyn 3	23:07	23:22	14 : 16.68
Miss Robyn 2	23:28	23:50	21 : 27.73
Miss Robyn 1	23:54	00:16	21 : 50.09
R.D. 102 - A	00:24	00:36	12 : 58.75
R.D. 102 - B	00:40	00:54	13 : 46.36
R.D. 102 - C	00:59	01:19	20 : 30.05
R.D. 102 - D	01:24	01:40	15 : 20.81
R.D. 102 - E	01:44	01:55	11 : 51.65

July 16/17 Depart Dawsons 2100, return 0330. Weather 50% cloud, clear after 2300, wind W 0-10. Fishery closed 1800. Only 1 or 2 jumpers each night so far.

Miss Robyn 6	22:50	22:57	7 : 57.27
Miss Robyn 5	23:00	23:10	10 : 19.77
Miss Robyn 4	23:14	23:26	11 : 17.76
Miss Robyn 3	23:30	23:44	13 : 37.04
Miss Robyn 2	23:52	00:13	20 : 45.70
Miss Robyn 1	00:19	00:38	18 : 48.69
R.D. 102 - A	00:43	00:56	13 : 27.34
R.D. 102 - B	00:59	00:15	15 : 24.01
R.D. 102 - C	01:20	01:40	20 : 17.77
R.D. 102 - D	01:45	02:00	14 : 56.29
R.D. 102 - E	02:04	02:16	12 : 29.79

July 17/18 Depart Dawsons 2100, return 0330. Weather clear most of the day, 20% overcast evening, clear after 2300, wind W 0-5. Targets concentrated on the north side of the inlet near Browns Bay. Some targets from Rutherford Point to Scandinavia Bay but nothing west of Stone Point.

Miss Robyn 6	22:52	23:00	8 : 35.09
Miss Robyn 5	23:03	23:12	9 : 40.06
Miss Robyn 4	23:16	23:30	12 : 59.75
Miss Robyn 3	23:35	23:48	13 : 13.72
Miss Robyn 2	23:54	00:15	20 : 47.10
Miss Robyn 1	00:20	00:40	20 : 00.85
R.D. 102 - A	00:48	01:00	12 : 29.12
R.D. 102 - B	01:03	01:16	13 : 45.88
R.D. 102 - C	01:22	01:44	22 : 25.21
R.D. 102 - D	01:49	02:02	12 : 51.52
R.D. 102 - E	02:06	02:17	11 : 01.84

July 18/19 Depart Dawsons 1900, return 0300. Weather clear, wind W 0-5. Indian Food Fish gillnet on transect 4. A few jumpers in the outer grid. Some targets in McIntyre Bay, nothing west of Stone Point.

Miss Robyn 6	22:32	22:41	3 : 56.00
Miss Robyn 5	22:43	22:53	10 : 13.34
Miss Robyn 4	22:57	23:09	12 : 04.12
Miss Robyn 3	23:14	23:29	14 : 19.13
Miss Robyn 2	23:36	23:57	21 : 22.49
Miss Robyn 1	00:02	00:22	19 : 22.48
R.D. 102 - A	00:29	00:42	13 : 35.46
R.D. 102 - B	00:44	00:58	13 : 19.44
R.D. 102 - C	01:03	01:25	22 : 06.10
R.D. 102 - D	01:30	01:47	16 : 17.32
R.D. 102 - E	01:50	02:03	11 : 56.40

July 19/20 Depart Dawsons 2030, return 0330. Weather clear, wind W 0-5. No jumpers. Some targets west of Stone Point. Most targets in the grid were concentrated on the north side of the inlet near Browns Bay.

Miss Robyn 6	22:34	22:44	9 : 28.80
Miss Robyn 5	22:45	22:55	9 : 55.12
Miss Robyn 4	23:00	23:14	13 : 48.61
Miss Robyn 3	23:20	23:33	13 : 45.68
Miss Robyn 2	23:42	00:04	22 : 26.19
Miss Robyn 1	00:10	00:31	21 : 15.60
R.D. 102 - A	00:37	00:51	13 : 30.95
R.D. 102 - B	00:54	01:08	13 : 45.97
R.D. 102 - C	01:13	01:34	21 : 04.68
R.D. 102 - D	01:39	01:55	16 : 19.32
R.D. 102 - E	01:59	02:12	12 : 50.73

July 20/21 Depart Dawsons 2100, return 0330. Weather clear, calm, E 0-5 after 2300. A few small schools on the grid at 2200. No jumpers. Very few targets in Browns Bay.

Miss Robyn 6	22:42	22:51	8 : 39.36
Miss Robyn 5	22:53	23:02	9 : 48.65
Miss Robyn 4	23:07	23:22	14 : 31.38
Miss Robyn 3	23:28	23:42	14 : 16.07
Miss Robyn 2	23:49	00:11	21 : 56.09
Miss Robyn 1	00:17	00:39	21 : 56.94
R.D. 102 - A	00:47	01:00	13 : 10.63
R.D. 102 - B	01:05	01:19	14 : 30.57
R.D. 102 - C	01:25	01:47	22 : 03.46
R.D. 102 - D	01:53	02:07	14 : 08.46
R.D. 102 - E	02:11	02:23	11 : 52.01

July 21/22 Depart Dawsons 2045, return 0315. Weather clear, wind W 0-5, fog after 2400. Few jumpers, very little on the sounder. Reports of fish moving up the Wannock River this morning. Targets concentrated in the center and on the south side of the inlet.

Miss Robyn 6	22:27	22:36	8 : 51.19
Miss Robyn 5	22:37	22:48	10 : 09.03
Miss Robyn 4	22:52	23:05	12 : 39.37
Miss Robyn 3	23:13	23:28	14 : 59.79
Miss Robyn 2	23:36	00:00	23 : 18.64
Miss Robyn 1	00:06	00:29	22 : 50.76
R.D. 102 - A	00:38	00:54	16 : 01.53
R.D. 102 - B	00:59	01:13	14 : 03.60
R.D. 102 - C	01:18	01:40	21 : 55.55
R.D. 102 - D	01:46	02:02	15 : 21.60
R.D. 102 - E	02:08	02:20	11 : 41.86

July 22/23 Depart Dawsons 2100, return 0330. Weather overcast, wind SW 5-15, 0.5 to 1 m chop, thunder. A few schools near the sport boundary on the color sounder, best so far. No jumpers. Stabilizers out for transects 6 to C.

Miss Robyn 6	22:37	22:47	10 : 15.20
Miss Robyn 5	22:49	23:02	13 : 20.06
Miss Robyn 4	23:08	23:20	12 : 01.21
Miss Robyn 3	23:27	23:41	13 : 39.96
Miss Robyn 2	23:51	00:14	23 : 23.82
Miss Robyn 1	00:21	00:41	20 : 15.92
R.D. 102 - A	00:50	01:04	14 : 14.71
R.D. 102 - B	01:10	01:25	14 : 40.55
R.D. 102 - C	01:30	01:52	22 : 07.30
R.D. 102 - D	02:01	02:15	14 : 37.12
R.D. 102 - E	02:21	02:35	14 : 00.24

July 23/24 Depart Dawsons 2100, return 0330. Weather overcast, wind W 0-10. Several schools on the color sounder (15 to 20), a few around grid 6 but most east of Shotbolt Bay. Reports of large numbers of fish moving up the Wannock River. Few jumpers. Most of the targets are on the south side of transects 2 to 6, D and E; in the middle on transects 1, A and B; and in Browns bay on transect C.

Miss Robyn 6	22:39	22:48	8 : 38.91
Miss Robyn 5	22:49	22:59	9 : 59.58
Miss Robyn 4	23:06	23:19	13 : 21.79
Miss Robyn 3	23:23	23:36	13 : 16.09
Miss Robyn 2	23:44	00:06	21 : 49.07
Miss Robyn 1	00:11	00:33	21 : 39.10
R.D. 102 - A	00:43	00:58	14 : 53.05
R.D. 102 - B	01:02	01:17	14 : 09.48
R.D. 102 - C	01:23	01:46	23 : 32.96
R.D. 102 - D	01:53	02:07	14 : 03.04
R.D. 102 - E	02:13	02:25	12 : 41.68

July 24/25 Depart Dawsons 2120, return 0400. Weather cloud 30%, wind W 0-5. 20 to 30 schools on the color sounder. Good showing of jumpers in Darby channel, suspect they were pinks.

Miss Robyn 6	23:13	23:21	8 : 12.73
Miss Robyn 5	23:23	23:32	8 : 39.98
Miss Robyn 4	23:37	23:48	11 : 36.44
Miss Robyn 3	23:53	00:06	13 : 07.40
Miss Robyn 2	00:13	00:36	22 : 41.06
Miss Robyn 1	00:42	01:02	20 : 31.02
R.D. 102 - A	01:11	01:25	14 : 27.34
R.D. 102 - B	01:31	01:44	13 : 48.72
R.D. 102 - C	01:50	02:11	21 : 31.08
R.D. 102 - D	02:17	02:32	14 : 27.17
R.D. 102 - E	02:38	02:51	12 : 47.82

Table 2: AREA 9 GILLNET FIELD CATCH FIGURES - 1990

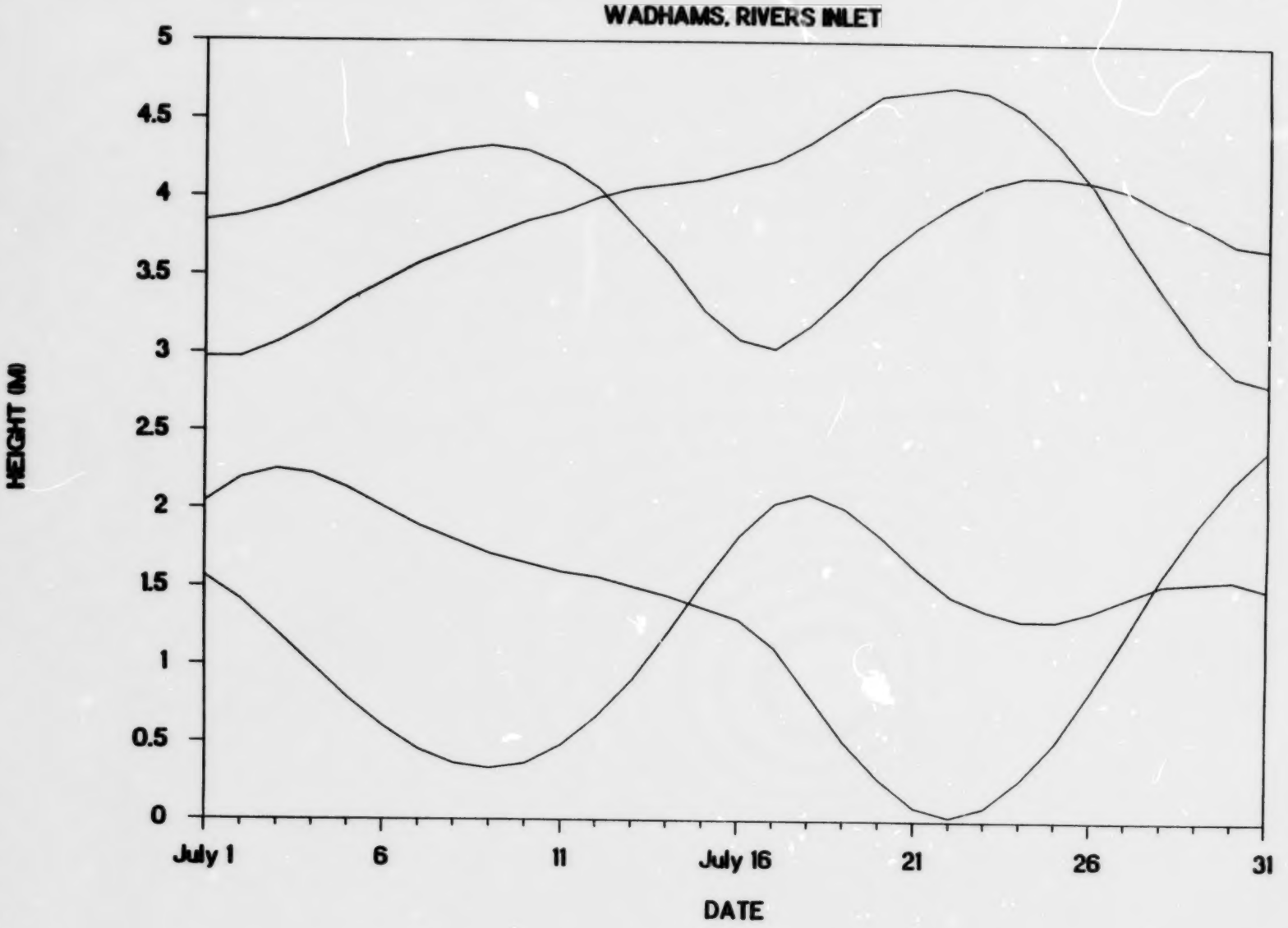
Date	Opr.	Sockeye	Coho	Pink	Chum	Chin.	Jack	Sthd.
02-Jul	335	3169	502	960	817	128	180	19
03-Jul	247	4379	850	1292	1187	164	93	8
TFW	582	7548	1352	2252	2004	292	273	27
TTD	582	7548	1352	2252	2004	292	273	27
09-Jul	449	34664	649	1176	1058	132	105	6
10-Jul	449	29753	693	1402	1513	132	60	7
TFW	898	64417	1342	2578	2571	264	165	13
TTD	1480	71965	2694	4830	4575	556	438	40
16-Jul	732	67423	311	14838	1321	145	110	7
TFW	732	67423	311	14838	1321	145	110	7
TTD	2212	139388	3005	19668	5896	701	548	47
23-Jul	CLOSED							
29-Jul	298	17745	327	14555	1320	85	55	2
TFW	298	17745	327	14555	1320	85	55	2
TTD	2510	157133	3332	34223	7216	786	603	49
06-Aug	101	12549	385	18030	931	102	36	1
07-Aug	100	5868	192	14162	623	46	7	2
08-Aug	67	6117	294	16044	1991	41	28	4
09-Aug	77	9064	253	14943	1107	50	26	3
TFW	345	33598	1124	63179	4652	239	97	10
TTD	2855	190731	4456	97402	11868	1025	700	59
13-Aug	58	4788	203	14569	477	33	12	0
14-Aug	55	3479	216	12697	653	33	15	2
15-Aug	43	1941	224	11434	588	15	9	0
TFW	156	10208	643	38700	1718	81	36	2
TTD	3011	200939	5099	136102	13586	1106	736	61
20-Aug	10	149	82	2375	131	4	0	0
21-Aug	15	279	100	6366	373	12	0	0
TFW	25	428	182	8741	504	16	0	0
TTD	3036	201367	5281	144843	14090	1122	736	61
27-Aug	4	46	25	937	54	0	0	0
28-Aug	3	15	12	403	87	0	0	0
29-Aug	3	10	14	599	98	0	0	0
TFW	10	71	51	1939	239	0	0	0
TTD	3046	201438	5332	146782	14329	1122	736	61

Table 3: 1990 RIVERS INLET SOCKEYE SCALE SAMPLES

		AGE					
DATE	TOTAL	3(1)	4(1)	4(2)	5(2)	5(3)	6(3)
03-Jul-90	86	3	9	8	63	1	2
09-Jul-90	67		1	2	61	1	2
16-Jul-90	83		1	6	66	3	7
06-Aug-90	99			13	81	3	2
13-Aug-90	147			11	135	1	
TOTAL	482	3	11	40	406	9	13
%	100.0%	0.6%	2.3%	8.3%	84.2%	1.9%	2.7%

Note: All data from the commercial gillnet fishery.
All ages from scales.

Figure 4: 1990 TIDE HEIGHTS (M)



Appendix 1: 1990 TIDE HEIGHT (m) AT WADHAMS, RIVERS INLET (PST).

Date	Time	Height (m)	Date	Time	Height (m)	Date	Time	Height (m)
July 1	01:58	1.6	July 11	02:17	4.2	July 21	06:13	0.1
	07:47	3.0		08:53	0.5		12:32	3.8
	13:18	2.0		15:12	3.9		18:08	1.6
	19:47	3.8		21:08	1.6	July 22	00:02	4.7
July 2	02:58	1.4	July 12	02:57	4.1		06:58	0.0
	09:07	3.0		09:28	0.7		13:17	4.0
	14:23	2.2		15:47	4.0		18:58	1.4
	20:42	3.9		21:53	1.6	July 23	00:52	4.7
July 3	03:58	1.2	July 13	03:42	3.8		07:43	0.1
	10:17	3.1		10:03	0.9		13:57	4.1
	15:23	2.3		16:27	4.1		19:43	1.4
	21:27	3.9		22:48	1.5	July 24	01:37	4.6
July 4	04:43	1.0	July 14	04:32	3.6		08:18	0.3
	11:07	3.2		10:43	1.2		14:32	4.1
	16:23	2.2		17:12	4.1		20:33	1.3
	22:17	4.0		23:48	1.4	July 25	02:22	4.4
July 5	05:28	0.8	July 15	05:37	3.3		08:58	0.5
	11:52	3.3		11:28	1.5		15:12	4.1
	17:08	2.1		18:02	4.1		21:18	1.3
	22:57	4.1	July 16	00:58	1.3	July 26	03:07	4.1
July 6	06:08	0.6		06:52	3.1		09:33	0.8
	12:27	3.5		12:28	1.8		15:47	4.1
	17:48	2.0		19:02	4.2		22:08	1.4
	23:42	4.2	July 17	02:13	1.1	July 27	03:52	3.7
July 7	06:43	0.5		08:27	3.0		10:08	1.2
	13:02	3.6		13:43	2.0		16:27	4.1
	18:28	1.9		20:07	4.2		22:58	1.4
July 8	00:17	4.3	July 18	03:28	0.8	July 28	04:42	3.4
	07:18	0.4		09:52	3.2		10:43	1.6
	13:32	3.7		15:03	2.1		17:07	3.9
	19:08	1.8		21:12	4.4		23:53	1.5
July 9	00:57	4.3	July 19	04:33	0.5	July 29	05:37	3.1
	07:48	0.3		10:57	3.4		11:18	1.9
	14:07	3.8		16:13	2.0		17:52	3.8
	19:43	1.7		22:12	4.5	July 30	00:58	1.6
July 10	01:37	4.3	July 20	05:28	0.3		06:52	2.9
	08:23	0.4		11:47	3.6		12:08	2.2
	14:37	3.8		17:13	1.8		18:47	3.7
	20:23	1.7		23:12	4.7	July 31	02:13	1.5
							08:32	2.8
							13:18	2.4
							19:47	3.7